BONNEVILLE POWER ADMINISTRATION

Lake Roosevelt Rainbow Trout Habitat/Passage Improvement Project

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Lake Roosevelt Rainbow Trout

Habitat/Passage Improvement Project

Annual Report

January 1998 - December 1998

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ABSTRACT
Lake Roosevelt Rainbow Trout Habitat/Passage Improvement Project

Lake Franklin D. Roosevelt was created with the completion of the Grand Coulee Dam in 1942. The lake stretches 151 miles up-stream to the International border between the United States and Canada at the 49th parallel. Increased recreational use, subsistence and sport fishing has resulted in intense interest and possible exploitation of the resources within the lake.

Previous studies of the lake and its fishery have been limited. Early studies indicate that natural reproduction within the lake and tributaries are not sufficient to support a rainbow trout (*Onchoryhnchus mykiss*) fishery (Scholz et. al., 1988). These studies indicate that the rainbow trout population may be limited by lack of suitable habitat for spawning and rearing (Scholz et. al., 1988).

The initial phase of this project (Phase I, baseline data collection) was directed at the assessment of limiting factors such as quality and quantity of available spawning gravel, identification of passage barriers, and assessment of other limiting factors. Population estimates were conducted using the Seber/LeCren removal/depletion method. After the initial assessment of stream parameters, several streams were selected for habitat/passage improvement projects (Phase II, implementation). At the completion of project habitat improvements, the final phase (Phase III, monitoring) began. This phase will assess changes and gauge the success achieved through the improvements.

The objective of the project is to correct passage barriers and improve habitat conditions of selected tributaries to Lake Roosevelt for adfluvial rainbow trout that utilize tributary streams for spawning and rearing. Streams with restorable habitats were selected for improvements. Completion of improvement efforts should increase the adfluvial rainbow trout contribution to the resident fishery in Lake Roosevelt.

Personnel of three co-operating agencies, the Confederated Tribes of the Colville Reservation (CCT), the Spokane Tribe of Indians (STI) and the Washington Department of Fish and Wildlife initiated the project fieldwork in 1990. Phase II included only the Confederated Tribes of the Colville Reservation and the Spokane Tribe of Indians. Phase III is being done by the Confederated Tribes of the Colville Reservation.

EXECUTIVE SUMMARY

The Lake Roosevelt Rainbow Trout Habitat/Passage Improvement Project is a mitigation project intended to partially mitigate for Fish and Wildlife losses suffered because of the construction of Grand Coulee Dam. Four streams on the Colville Indian Reservation and one on the Spokane Indian Reservation were selected: South Nanamkin, North Nanamkin, Louie and Iron Creeks on the Colville Reservation, and Blue Creek on the Spokane Reservation.

Several studies were developed to design structures and meanders. Improvements included in-stream habitat structures, culvert replacements, fencing, meander reconstruction, bank stabilization, riparian plantings, and an irrigation water diversion repair. Over a time period of approximately four years these improvements/enhancements were installed. After the improvements were done, monitoring started which includes, on an annual basis, juvenile and adult trapping, juvenile population estimates, and habitat inventory.

INTRODUCTION:

HISTORICAL BACKGROUND

Since the loss of salmon above Grand Coulee Dam, fishery enhancement measures have been limited on the reservoir. A few short term fisheries surveys were conducted on the reservoir along with the introduction of fish species by the Washington Department of Wildlife (WDW), Washington Department of Fisheries (WDF), Spokane Indian Tribe (Spokane Tribe), and the Confederated Tribes of the Colville Reservation (CCT). Studies have shown that existing spawning habitat in Lake Roosevelt tributary streams may be inadequate to sustain a rainbow trout *(Oncorhynchus mykiss*) fishery in Lake Roosevelt (Scholz et. al., 1988). Upstream migration passage barriers limit the amount of spawning and rearing habitat that might otherwise be utilized by rainbow trout. Limited stream surveys and habitat inventories indicate that a potential for increased natural production exists. The lack of any comprehensive enhancement measures prompted the Upper Columbia United Tribes Fisheries Center (UCUT), Colville Confederated Tribes (CCT), Spokane Tribe of Indians (STI) and Washington Department of Fish and Wildlife (WDFW) to develop a comprehensive fishery management plan for Lake Roosevelt (Scholz et. al., 1988). The Rainbow Trout Habitat/Passage Improvement Project (LRHIP) was designed with goals directed towards increasing natural production while maintaining genetic integrity among current tributary stocks.

The plan was amended into the Columbia River Basin Fish and Wildlife Program by the Northwest Power Planning Council (NPPC) in 1987 (NPPC, 1987). Program Measures 903 (g) (1)(c)(d)(e) directed Bonneville Power Administration (BPA) to fund "improvement of spawning and rearing habitat in order to facilitate passage to spawning tributaries to increase natural production of rainbow trout" and "evaluate the effectiveness of the above measures by conducting a monitoring program".
The interagency team of the Colville Confederated Tribes (CCT), Spokane Tribe of Indians (STI), Washington Department of Wildlife (WDW), and the Upper Columbia United Tribes (UCUT) selected the streams for habitat evaluation.

DESCRIPTION OF STUDY AREA

Lake Franklin D. Roosevelt reaches upstream from the Grand Coulee Dam, 151 miles to the Canadian border. Approximately 494 miles of shoreline exist where sixty-five (65) tributary streams contribute their flow and biomass to the fishery in the lake. Ferry, Stevens, Spokane, Lincoln, Grant and Okanogan Counties border the shoreline and study areas. The area lies within the Okanogan Highland geological district. The land habitat surrounding this lake is diverse, habitats range from coniferous forest, lush lowlands to semi-arid shrub steppe. Annual rainfall regimes (10 inches/year at low elevation, to 35 at the highest elevation) greatly affect the climate of the area. Annual temperatures range from winter lows of -40 degrees F. to summer highs of 100 + F.

During earlier historic periods this area hosted vast numbers of salmon returning to their natal waters to reproduce and die. Salmon and steelhead provided sustenance, the religious focus and cultural basis of the native people of the region. In death, their decaying carcasses provided untold amounts of nutrients re-cycled into the ecosystem.

Near the present site of Kettle Falls, WA., the second largest Indian fishery in the state existed for thousands of years. Returning salmon were caught in nets, baskets or speared on their migration to the headwater of the Columbia River in British Columbia. Other lessor, but important, fishery sites existed south of Kettle Falls at Rickey Rapids and at the Little Spokane Falls. Catch estimates at Kettle Falls range from 600,000 in 1940 to 1-2 million around the turn of the century (UCUT, Report #2).

Annual gatherings at the various fishing sites brought together many bands of native people for fishing, socializing and religious activities. The rumble of the great Kettle Falls could be heard from as far away as 10 miles (UCUT, Rep #2). The roar of the falls was silenced forever in 1943 when the backwaters of Grand Coulee Dam inundated the falls. Lost forever to the native people of the area and all other region residents were the diversity of the salmon runs, economy to the area, nutrient contribution to the upper Columbia area, religious significance of and the culture linked to vast salmon runs. Historians generally agree that by the turn of the century, the once limitless runs were beginning to decline due to the intense salmon fishery on the lower Columbia near Portland OR. (UCUT, Report #2).

SCOPE OF PROJECT

OBJECTIVE

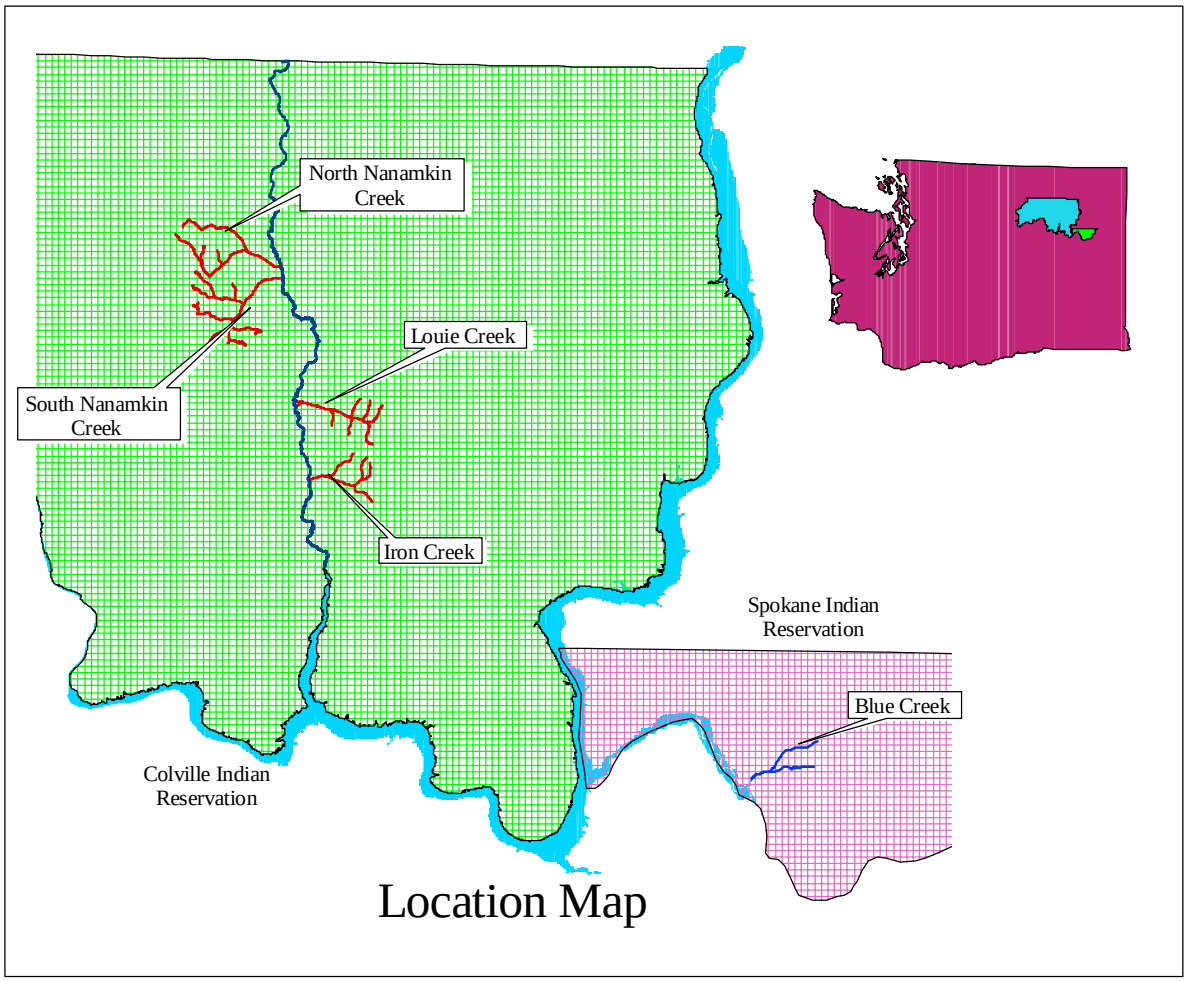
The objective of all three phases is to enhance and protect the natural spawning adfluvial rainbow trout of Lake Roosevelt. A habitat passage improvement plan was developed using the data collected by field teams from the two co-operating agencies; the Colville Confederated Tribes (CCT) and the Spokane Tribe of Indians (STI). Projects that will remove passage barriers, reduce sediment loading, improve or protect existing riparian vegetation, provide habitat diversity and protect the genetic integrity of rainbow trout within the system will be prioritized for implementation.

GOAL

The goal of this project is to increase the quality and quantity of rainbow trout spawning and rearing habitat available to adfluvial rainbow trout with an emphasis on increasing the survival of wild and/or natural stocks. This goal will be achieved by protecting and improving the habitat of the stocks indigenous to Lake Roosevelt. Ultimately, this will increase the contribution of adfluvial rainbow trout to the fishery in the lake. Stream improvements were accomplished using established methodologies (Hunter, 1991; Rosgen, 1986; Wesche, 1985) and through training from Dr. Donald R. Reichmuth, Dr. David Rosgen, Dr. John Orsborn P.E. and a fish habitat management short course at Utah State University (multiple educators). Improvements may include removal of passage barriers, realignment of stream channel, resetting of culverts, re-establishment of stream meanders, and addition of log stump, rootwad and boulder structures in selected streams. Some streams only need to have a culvert re-installed on grade to eliminate a passage barrier. Others will require the use of several structures to create better habitat and diversity. Finally, the project will utilize TFW ambient monitoring methodologies to monitor and evaluate the effects of improvements on all physical and biological parameters enumerated during the course of the project. Collection of baseline data included classification and enumeration of various stream parameters and also included riparian vegetation, fish population estimates, biomass and densities.

MONITORING/METHODS

The first spring season following the completion of the implementation phase, the project began the monitoring phase. The monitoring phase will be conducted using the same methodologies as before (TFW ambient monitoring). Follow up monitoring will be only conducted on streams where habitat/passage improvements were put into service. In addition to employing the ambient monitoring methods, an assessment of the number of returning adfluvial rainbow trout spawners will be done. Out-migrating juvenile rainbow trout numbers will also be done in conjunction with the adult enumeration. Adult spawner enumeration will be done using a picket fence type of trap at the mouths of the streams. Other methods will include foot surveys, and redd counts. Out-migrating juvenile assessment will be done using traps having a holding box and a fyke type net. Traps will be maintained on a daily basis including weekends and holidays. The time frame for the monitoring phase will run through the year 2000. The annual and final reports will consider the effectiveness of the implementation efforts.



RESULTS- 1998

The data collection in 1998 was incomplete for a couple of reasons (note this author was not the project biologist for most of 1998). In spring, high flows prevented data collection equipment from operating correctly (trapping data). The velocity, bedload movement and turbidity prevented a long period of data collection; technicians could not enter the streams without high risk. The remainder of the data collection occurred in late summer-fall. Below are summary tables of data taken in 1998 and maps of original valley segments in 1990-1991.

Table 1. Adult Trapping Data (length in millimeters, weight in grams).

Stream	# of Adults	Sex Ratio	Ave. Weight	Max Weight	Min Weight	Ave. Length	Max Length	Min Length
Blue Creek	No Data							
Iron Creek	9	5m/4f	1115	1430	524	459	525	301
Louie Creek	9	5m/4f	1481	1758	1028	510	585	458
North Nanamkin	19	7m/12f	1342	1724	1105	498	546	470
South Nanamkin	0							
Total	**37**							

Table 2. Juvenile Trapping Data (length in millimeters, weight in grams).

Stream	# of fish	Ave. Weight	Max. Weight	Min. Weight	Ave. Length	Max. Length	Min. Length
Blue Creek	No Data						
Iron Creek	145	3.3	74	0.6	58	187	35
Louie Creek	98	2.5	18	0.7	59	124	36
North Nanamkin	96	2.3	7.4	0.5	56	96	35
South Nanamkin	No Data						
Total	**339**						

Table 3. Habitat Survey Results.

Stream	Pool Area (sq. m.)	Riffle Area	Sq. M. Riffle/ 1 Sq. M. Pool	Width/ Depth Ratio	LWD/ Mile1*	LWD/ Mile2*	%Shade
Blue Creek VS1	2521.1	4495.4	1.8	11.2	42	27	No Data
Blue Creek VS2	1398.6	5124.7	3.7	13.0	51	30	No Data
Blue Creek VS3	26.3	64.8	2.5	No Data	457	161	No Data
Iron Creek VS1	45.3	575.6	12.7	29.0	49	8	16
Iron Creek VS2	753.7	2151.5	2.9	17.8	37	26	66
Louie Creek VS1	142.7	584.9	4.1	15.0	263	119	No Data
Louie Creek VS2	689.3	3810.7	5.5	15.7	62	31	No Data
North Nanamkin VS 1	318.7	1424.1	4.5	48.0	62	12	21
North Nanamkin VS 2	1601.9	6034.1	3.8	23.7	89	42	44
North Nanamkin VS 3	41.6	284.5	6.8	25.0	157	49	66
South Nanamkin VS1	471.6	1065.4	2.3	22.5	0	0	12
South Nanamkin VS2	1096.4	4356	4	26.5	77	37	61
South Nanamkin VS3	759.4	2781.7	3.7	26.0	116	84	53

*Large woody debris- 1 is 4-10 inches in diameter, 2 is >10 inches in diameter. These are rates for each segment; most segments are less than a mile long.

A total of 28 adult and 339 juvenile fish were trapped in spring (tables 1 and 2). Technicians noted that some adult avoidance of traps was seen at North and South Nanamkin Creeks. Adults would remain in pools downstream from the trap. As soon as high flows occurred the trap was no longer an obstruction to the fish. It is unknown whether these fish spawned above the traps or moved back into the San Poil River and elsewhere to spawn.

Large woody debris (LWD) data were originally taken in 1990-1991, but were not in 1996 or 1997. This fall, 1998, LWD was incorporated in the survey protocol using similar guidelines used in 1990-1991; 6 feet or longer, 4 inches or greater in diameter and at least half the length within the bankfull width (Table 3). Also incorporated were pebble counts; 100 or greater total count, measured in perpendicular, to stream flow, transects within habitat units that were electroshocked for fish population estimates. Substrate sizes are as follows: 0-0.6mm is sand, 0.6mm-10cm gravel, 10cm-30cm cobble, >30cm boulder and bedrock (see table 5). An analysis was done to determine if there is a relationship of substrate, and other parameters, to fish density (table 4) in pools and riffles using regression, but the best fit for any parameter examined was poor (the best r^2 was 0.45 when fish density was compared to pool area; substrate compared with fish density was less than a 0.10 value). Also, comparisons between years will be done in the future. In 1990-1991 substrate counts were done, but the methodology was inconsistent; most were done counting the types of substrate encountered moving upstream in a reference section, but not as a transect across the stream channel.

The pools and riffles electroshocked were selected at random. Approximately 10 percent of each habitat type, by area in the valley segment, were shocked. Juvenile fish population estimates, rainbow trout only, (table 4) per valley segment were calculated by averaging fish density per pool or riffle and multiplying that by the area in each category respectively. Data summarized in valley segment (VS) three

Table 4. Juvenile Population Estimates.

Stream	Sampled Area (sq. m)	Total Area, from habitat surveys	#fish/sq. meter	Population Estimate
Blue Creek VS1	614.3	7016.5		2214
Pools Only	272.1	2521.1	**.7**	
Riffles Only	342.2	4495.4	**.1**	
Blue Creek VS2	229.2	6523.3		3309
Pools Only	54.5	1398.6	**.9**	
Riffles Only	174.7	5124.7	**.4**	
Blue Creek VS3	No Data	91.1		
Iron Creek VS1	57.8	620.9		173
Pools Only	0	45.3	**0**	
Riffles Only	57.8	575.6	**0.3**	
Iron Creek VS2	298.3	2905.2		4165
Pools Only	79.6	753.7	**2.1**	
Riffles Only	218.7	2151.5	**1.2**	
Louie Creek VS1	97	727.6		885
Pools Only	25	142.7	**2.1**	
Riffles Only	72	584.9	**1.0**	
Louie Creek VS2	400.7	4500.0		8263
Pools Only	46.6	689.3	**4.8**	
Riffles Only	354.1	3810.7	**1.3**	
North Nanamkin VS1	286.8	1742.8		1252
Pools Only	58	318.7	**0.8**	
Riffles Only	228.8	1424.1	**0.7**	
North Nanamkin VS2	979.8	7636.0		11075
Pools Only	186.9	1601.9	**3.9**	
Riffles Only	792.9	6034.1	**0.8**	
North Nanamkin VS3	30.6	326.1		927
Pools Only	4.1	41.6	**9.3**	
Riffles Only	26.5	284.5	**1.9**	
South Nanamkin VS1	201.2	1537.0		3306
Pools Only	111.5	471.6	**4.3**	
Riffles Only	89.7	1065.4	**1.2**	
South Nanamkin VS2	547.1	5452.4		6872
Pools Only	230.3	1096.4	**1.5**	
Riffles Only	316.8	4356.0	**1.2**	
South Nanamkin VS3	570.6	3541.1		2352
Pools Only	183.7	759.4	**0.9**	
Riffles Only	386.9	2781.7	**0.6**	

Table 5. Substrate survey results.

Stream	Percent Sand	Gravel	Cobble	Boulder	Bedrock
Blue Creek VS1	32.7	33.4	27.3	6.5	0
Pools Only	45	33	17	9	0
Riffles Only	16	34	41	5	0
Blue Creek VS2	28.9	33.2	30.0	8.0	0
Pools Only	37	36	23	4	0
Riffles Only	22	31	35	11	0
Blue Creek VS3	No Data				
Iron Creek VS1	3.8	47.6	39.0	9.5	0
Pools Only					
Riffles Only	3.8	47.6	39.0	9.5	0
Iron Creek VS2	4.9	54.2	32.8	8.0	0
Pools Only	4	48	37	7	0
Riffles Only	5	57	31	10	0
Louie Creek VS1	24.0	54.1	21.9	0	0
Pools Only	31	56	34	0	0
Riffles Only	15	51	13	0	0
Louie Creek VS2	20.3	30.5	35.5	13.7	0
Pools Only	35	40	20	5	0
Riffles Only	11	24	46	19	0
North Nanamkin VS1	17.1	64.2	16.5	2.3	0
Pools Only	17	61	18	5	0
Riffles Only	17	68	15	0	0
North Nanamkin VS2	11.5	55.8	28.0	4.8	0
Pools Only	16	55	25	4	0
Riffles Only	7	57	31	5	0
North Nanamkin VS3	4.7	32.1	31.2	32.0	0
Pools Only	5	28	26	41	0
Riffles Only	4	37	37	23	0
South Nanamkin VS1	13.9	70.8	14.3	0.9	0
Pools Only	20	67	12	2	0
Riffles Only	9	74	17	0	0
South Nanamkin VS2	10.1	43.6	34.6	10.0	1.7
Pools Only	12	48	29	10	2
Riffles Only	8	38	43	10	2
South Nanamkin VS3	10.4	41.5	32.4	14.3	1.5
Pools Only	10	42	30	16	1.7
Riffles Only	10	40	37	12	1

for Blue and North Nanamkin Creeks should be viewed with caution. The survey length and area was small enough that data is biased for most/all parameters analyzed for those segments. Blue Creek VS3 had no population estimates done (no electroshocking was done). Valley segment one on Iron Creek was not separated until after habitat and electroshocking surveys were done, therefore no sampling was actually done to analyze the fish density in pools for that segment. In Blue Creek eight hatchery rainbow trout were electroshocked, but were not included in the population estimates. Sculpins (*Cottus sp.*) were found in all five streams, and one eastern brook trout in Blue Creek.

In October a survey was done to determine plant survival on North and South Nanamkin Creeks. Approximately five percent of the plants have survived. Counts were probably underestimated due to the time of year; fall leaf drop had occurred on 60-70% of the deciduous plants by the time the survey was done. Many of the plants have been grazed by livestock. Deer may have grazed some plants. Some beaver damage has occurred in prior years. The fencing that was installed to prevent livestock damage to riparian plants is in need of repair. Several sections of fence are presently down and will need repairing this spring (1999). Hanging gates where the stream enters or leaves a fenced section are also in need of repair. In most instances, hanging gates were not removed in winter and were still in place when spring floodwaters occurred. At all but one gate, large gravel bars have formed, and in some cases some damage to the channel has occurred. All gates were removed in November/December to prevent this from occurring this spring.

In-stream structures were examined and counted to determine effectiveness. Table 6 below depicts the results. Structures in Blue Creek were counted and assessed during the habitat surveys. The number of structures not found in Blue Creek is the same as in 1996, as reported by STI.

Table 6. In-stream Structures.

Stream	Original number of structures	Presently functional	Bedload filled	Washed out	Not found
Blue Creek	71	14	10	17	30
Iron Creek	11	8	1	2	0
Louie Creek	6	0	0	6	0
North Nanamkin	24	11	8	4	1
South Nanamkin	14	8	2	4	0

In November a contractor removed several yards of gravel from North Nanamkin below Highway 21. It was thought that the hanging gates left in place during high flows caused depositional zones to occur. No cost was incurred, as the contractor was doing the work as off site mitigation from another area. Work was completed in one and a half days, November 29th and 30th 1998. North Nanamkin had previously created a new channel (channel 2) south of that created for this project (channel 1). Channel 1 was cleared of gravel and sand and channel 2 blocked with the material, but not filled beyond that point. This was done in the event the hanging gates were not the only problem causing the deposition problem. Around December 12th flood flows occurred equal to a 25-year flood event (rain on snow). The gates were not the only problem. It appears that the meanders created during the second phase of this project slow the flow down enough that the bedload drops out and fills the channel before a channel turn below the gates. Presently the water flow moves through both channel 1 (40%) and channel 2 (60%).

The flow pattern of North Nanamkin has changed due to logging and road building within the watershed. These activities have been occurring over the last 1-2 years. The activities are basically finished now. This fall North Nanamkin started flowing 3-4 weeks before, and at a higher rate, than South Nanamkin. Note that North and South Nanamkin Creeks both have segments (VS1 for both) that usually go dry for 1-3 months during the dry season depending on annual precipitation. It has been common knowledge to the technicians and local residents that South Nanamkin Creek always starts flowing before North Nanamkin. It would appear that the logging activities have had an effect to the flow pattern and may have contributed the large bedload movement discussed above.

North Nanamkin Channel Reconstruction November 29-30, 1998.

Pictures 1 and 2. North Nanamkin before bedload removal (11/29/98).

Picture 3. North Nanamkin above water access.

Picture 4. Bedload removal with track-hoe.

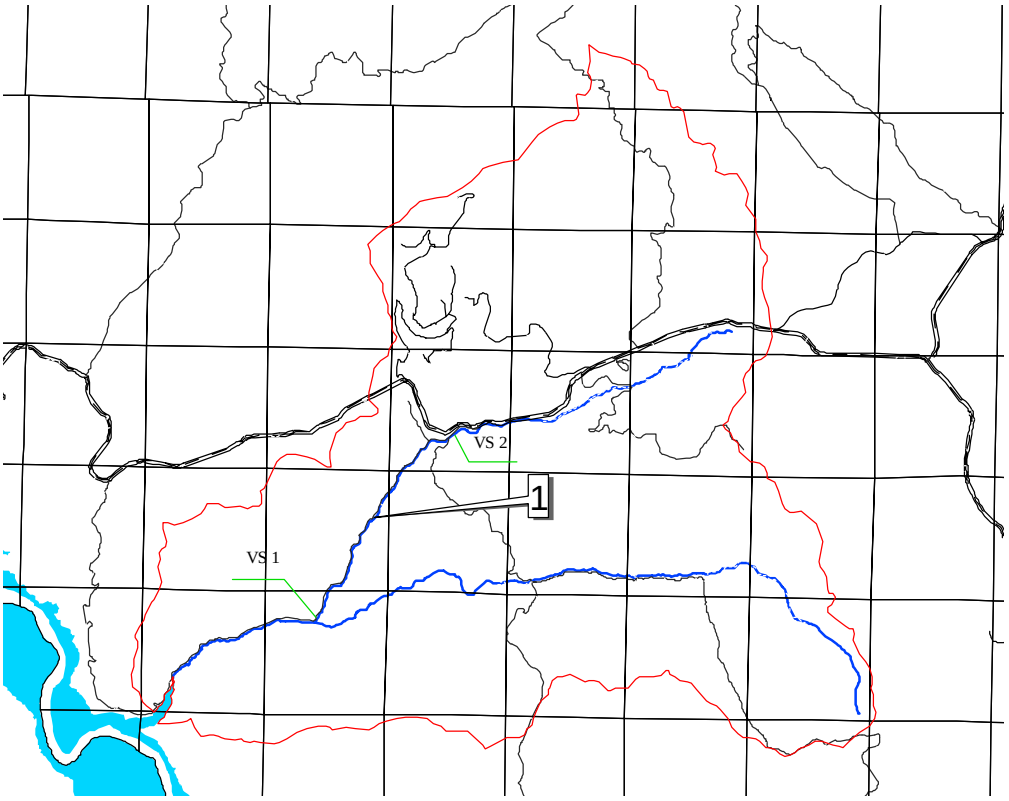
Pictures 5 and 6. North Nanamkin when water is released into repaired channel.

North Nanamkin Channel Reconstruction
After December 12, 1998 Flood Event.

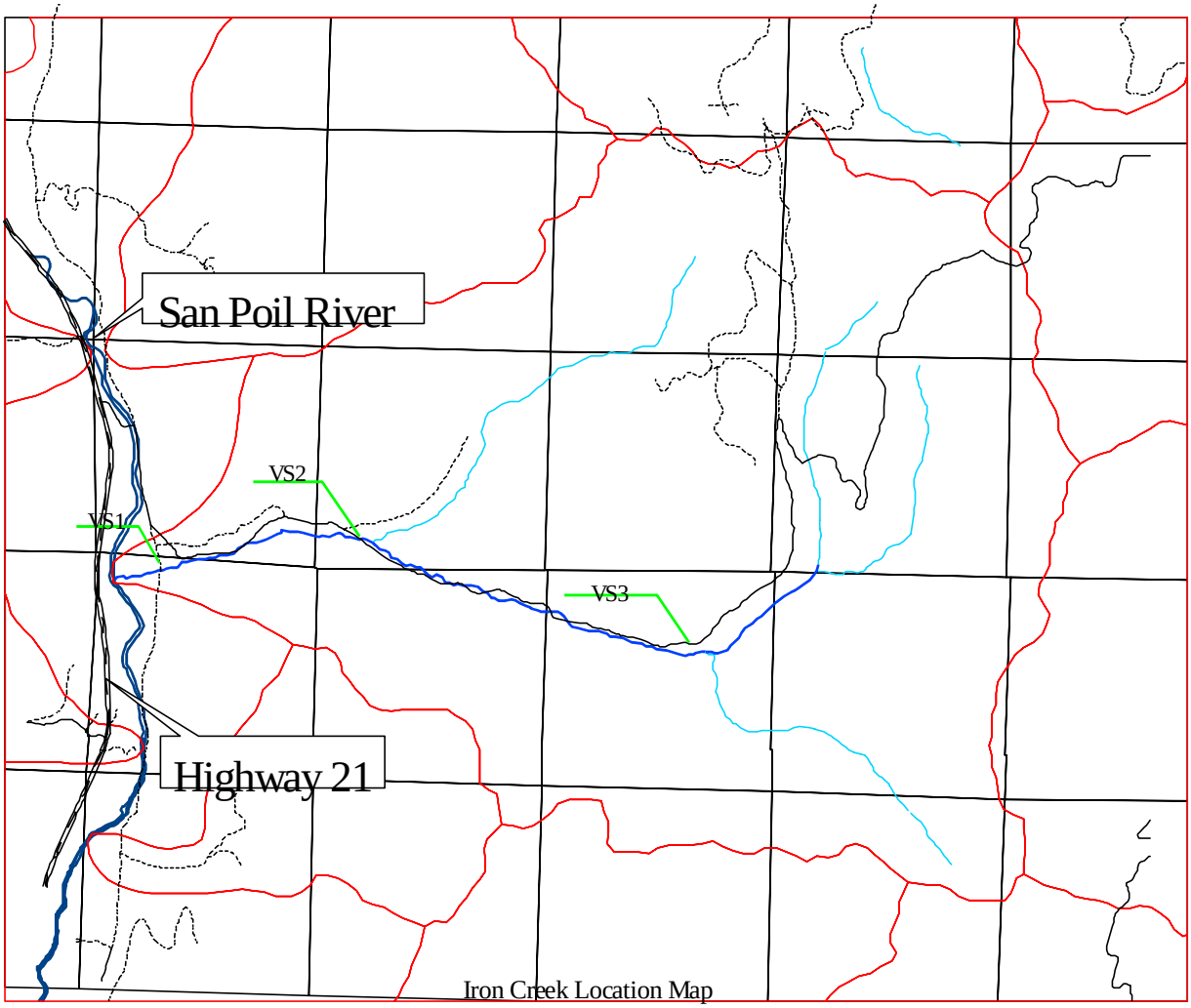

Pictures 7 and 8. North Nanamkin; compare to pictures 1, 6 and 4, above, respectively.


Pictures 9 and 10. North Nanamkin; compare picture 9 to 2 and 4 above.

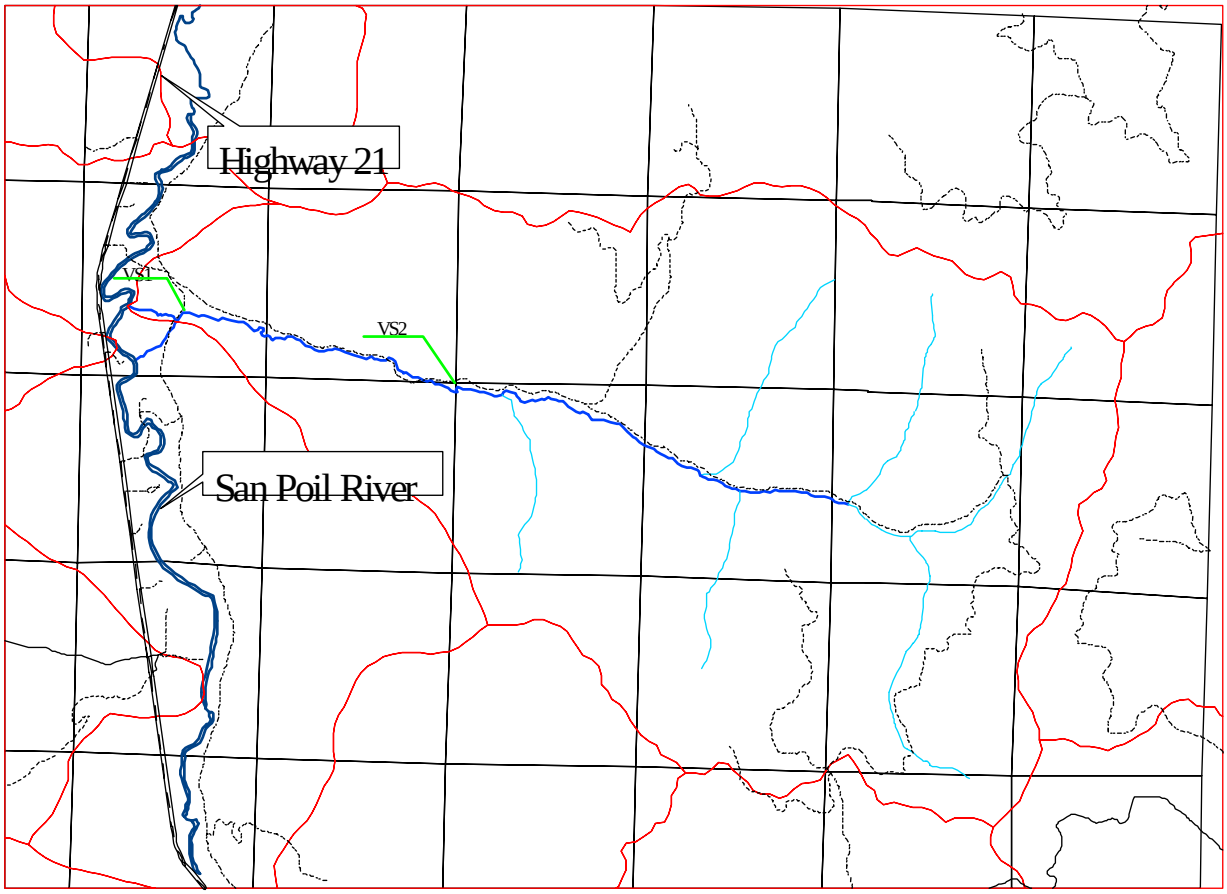
Picture 11. North Nanamkin where two channels converge.



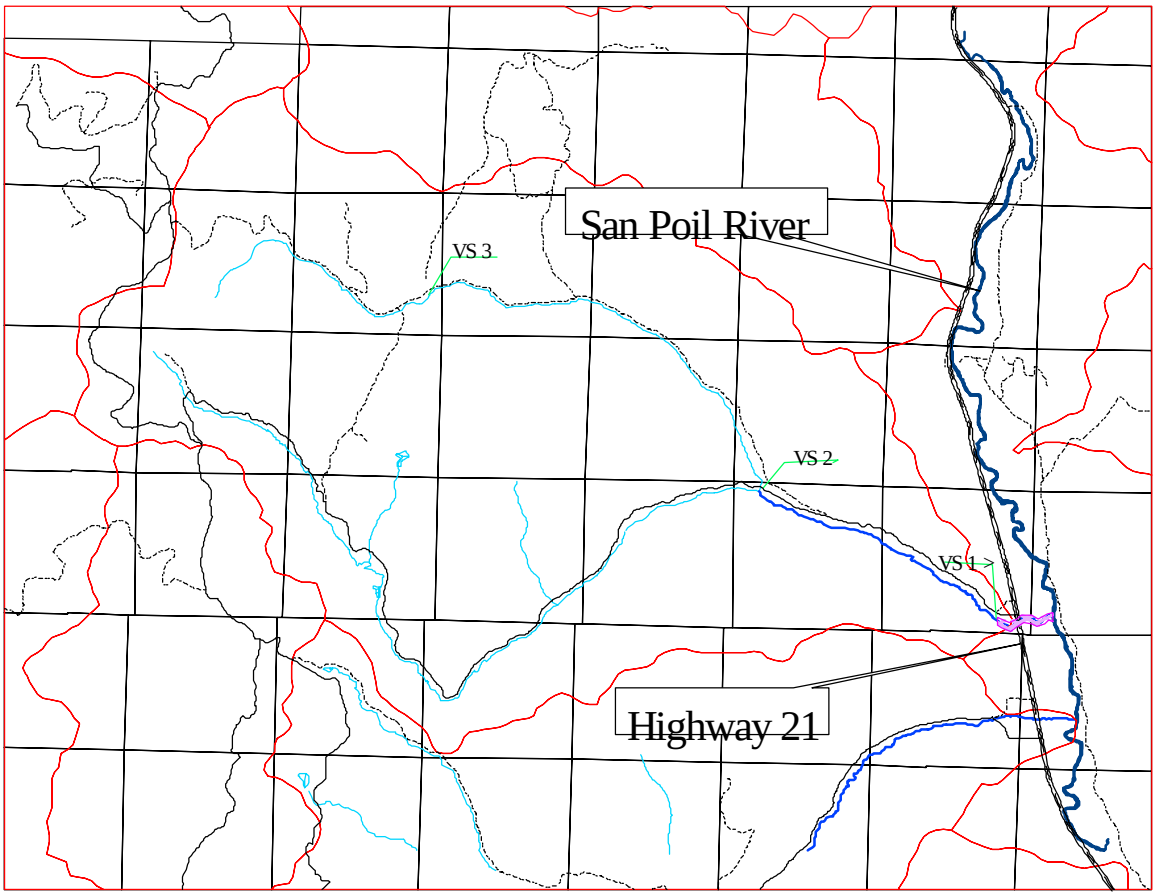
Blue Creek Location Map



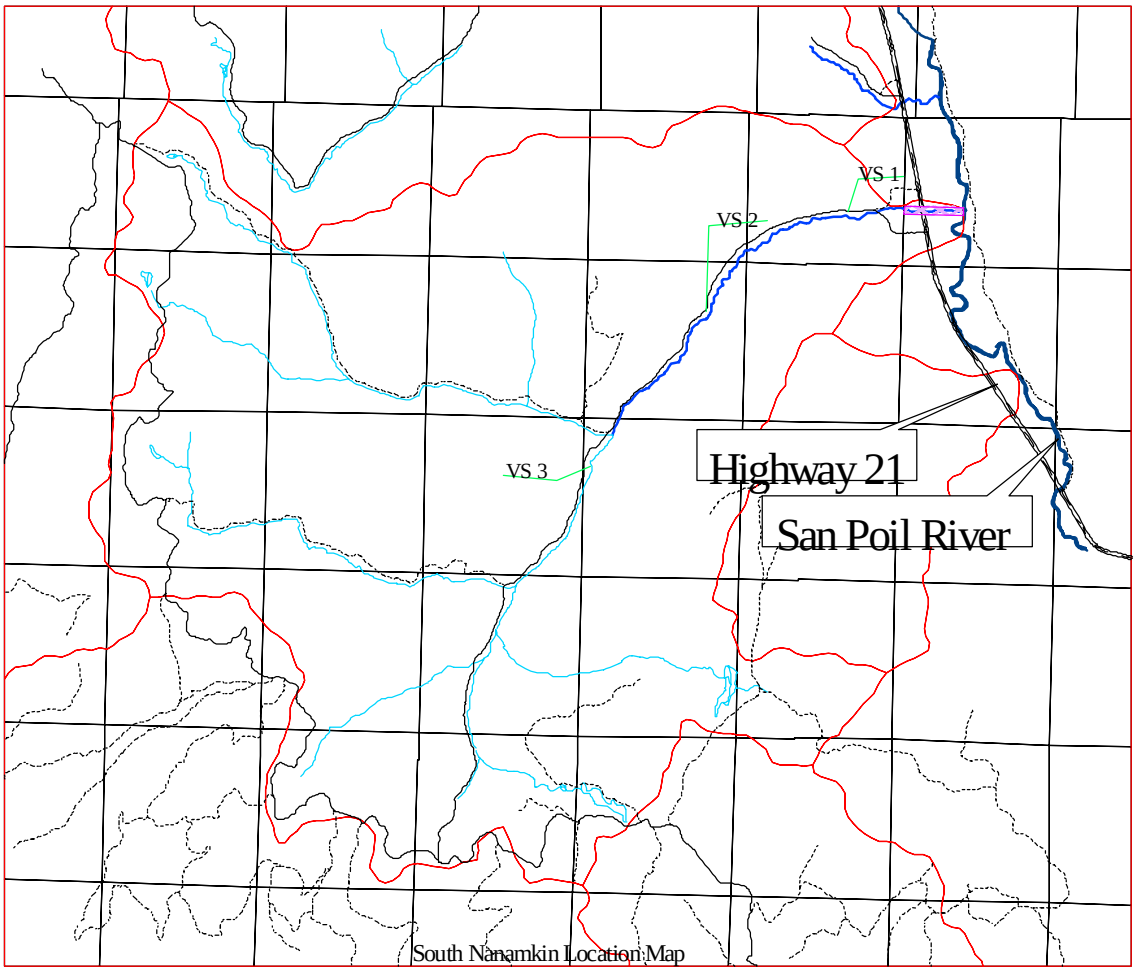
Iron Creek Location Map



Louie Creek Location Map



North Nanamkin Location Map



South Nanamkin Location Map